exposed to an interior of the combustion chamber is formed into a protruded shape without forming a corner portion or a recessed portion on a surface thereof.

If the nozzle body tip portion is not formed such that the entire nozzle body tip portion is protruded and free from a corner portion, heat generated by combustion tends to concentrate at the corner portion. The temperature of the nozzle hole, therefore, tends to increase because of heat conduction from the corner portion, thus promoting accumulation of deposits. When there is a recessed portion on the surface thereof, heat generated by combustion increases the temperature of the nozzle body tip portion is conducted from the surface enlarged by the recessed portion and, which results in easily increasing the temperature of the nozzle hole. This again in turn promotes accumulation of deposits.

Contrary to that, if the entire nozzle body tip portion of the fuel injection valve body is formed into a protruded shape without forming a corner portion or a recessed portion on the surface thereof, no corner portions are formed and the surface is not unnecessarily enlarged. As a result, the temperature of the nozzle hole can be prevented from increasing and accumulation of deposits can be restricted.

To achieve the foregoing object, a fuel injection valve body for a direct injection type internal combustion engine that injects fuel directly into a combustion chamber of the internal combustion engine may comprise a nozzle body tip portion which forms a nozzle hole therein and is exposed to an interior of the combustion chamber, and a cap disposed on a periphery of the nozzle body so as to secure the nozzle body onto a main body side of the fuel injection valve body. In this arrangement, a continuous tip portion is formed of the nozzle body tip portion and tip

of the cap. The entire continuous tip portion is formed in a protruded shape without forming a corner portion or a recessed portion on a surface thereof.

The continuous tip portion prevents the temperature of the tip portion of the cap from increasing, thus preventing the temperature of the nozzle body tip portion from increasing through heat conduction from the tip portion of the cap. Therefore, the temperature of the nozzle hole can be prevented from increasing and accumulation of deposits can be restricted.

To achieve the foregoing object, according to a yet further aspect of the invention, a fuel injection valve body for a direct injection type internal combustion engine that injects fuel directly into a combustion chamber of the internal combustion engine may be provided, wherein a part of a nozzle body tip portion, in which a nozzle hole is formed and which is exposed to an interior of the combustion chamber, is covered through a gap with a tip portion of a cap, which is disposed on a periphery of the nozzle body so as to secure the nozzle body onto a main body side.

The arrangement, in which a part of the nozzle body tip portion is covered with the tip portion of the cap through the gap, reduces a part of the nozzle body tip portion that is exposed to combustion flame, which prevents the temperature of the nozzle body tip portion from increasing. In addition, thanks to the gap, heat is not directly conducted to the nozzle body tip portion even when the temperature of the tip portion of the cap increases, which effectively prevents the temperature of the nozzle body tip portion from increasing caused by heat transfer from the tip portion of the cap. Therefore, the temperature of the nozzle hole can be prevented from increasing and accumulation of deposits can be restricted.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features, advantages, technical and industrial significance of this invention will be better understood by reading the following detailed description of preferred embodiments of the invention, when considered in connection with the accompanying drawings, in which:

[Fig. 1] Fig. 1 is a schematic longitudinal sectional view showing a direct injection type gasoline engine to which a fuel injection valve according to a first embodiment of the invention is mounted.

[Fig. 2A] Fig. 2A is a front view showing a tip portion of the fuel injection valve according to the first embodiment of the invention.

[Fig. 2B] Fig. 2B is a longitudinal sectional view showing the tip portion of the fuel injection valve according to the first embodiment of the invention.

[Fig. 3A] Fig. 3A is a front view showing a tip portion of the fuel injection valve according to a second embodiment of the invention.

[Fig. 3B] Fig. 3B is a longitudinal sectional view showing the tip portion of the fuel injection valve according to the second embodiment of the invention.

[Fig. 4A] Fig. 4A is a front view showing a tip portion of the fuel injection valve according to a third embodiment of the invention.

[Fig. 4B] Fig. 4B is a longitudinal sectional view showing the tip portion of the fuel injection valve according to the third embodiment of the invention.

[Fig. 5A] Fig. 5A is a front view showing a tip portion of the fuel injection valve according to a fourth embodiment of the invention.